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$\frac{c^2+d^2-x^2}{2cd}$. Put $\frac{a^2+b^2}{2ab}=m$, $\frac{1}{2ab}=n$, $\frac{c^2+d^2}{2cd}=p$, and $\frac{1}{2cd}=q$. We find, on eliminating ψ, and reducing,

$$x^4-2\left[\frac{mn-(mq+np)\cos\theta+pq}{n^2-2nq\cos\theta+q^2}\right]x^2=-\frac{m^2-2mp\cos\theta+p^2-\sin^2\theta}{n^2-2nq\cos\theta+q^2}$$

$$\therefore x=\sqrt{\frac{mn-(mq+np)\cos\theta+pq\pm\sin\theta\sqrt{[n^2-2nq\cos\theta+q^2-(mq-np)^2]}}{n^2-2nq\cos\theta+q^2}}$$

Replacing in this, for m, n, p, and q their equivalents in a, b, c, and d, we have,

$$x=\sqrt{\frac{\begin{array}{c}a^2b^2(c^2+d^2)-abcd(a^2+b^2+c^2+d^2)\cos\theta+c^2d^2(a^2+b^2)*\\ *\pm abcd\sin\theta\sqrt{[4(a^2b^2-2abcd\cos\theta+c^2d^2)-(a^2+b^2-c^2-d^2)^2]}\end{array}}{\sqrt{(a^2b^2-2abcd\cos\theta+c^2d^2)}}}$$

For y, we must put b for d in value for x. Also, $-\sin\theta$ for $\sin\theta$, since $\sin(360^\circ-\theta)=-\sin\theta$. Then

$$y=\sqrt{\frac{\begin{array}{c}a^2d^2(b^2+c^2)-abcd(a^2+b^2+c^2+d^2)\cos\theta+b^2c^2(a^2+d^2)*\\ *\mp abcd\sin\theta\sqrt{[4(a^2d^2-2abcd\cos\theta+b^2c^2-(a^2-b^2-c^2+d^2)^2]}\end{array}}{\sqrt{(a^2d^2-2abcd\cos\theta+b^2c^2)}}}$$

When $ABC+ADC>180^\circ$, $AC<BD$, and the plus sign is to be used before $abcd\sin\theta$ for x, and the minus sign before the same for y. This is, of course, reversed when $ABC+ADC<180^\circ$.

381. Proposed by J. SCHEFFER, A. M., Hagerstown, Md.

Find the number of diagonals of a *complete* polygon of n sides.

I. Solution by J. OWEN MAHONEY, B. E., M. Sc., Central High School, Dallas, Texas.

An incomplete polygon of n sides has $\frac{n}{2}(n-3)$ diagonals. The complete polygon of n sides has $\frac{n}{2}(n-1)$ vertices or $\frac{n}{2}(n-3)$ more than the incomplete polygon of n sides. Hence, the number of diagonals of the complete figure is,

$$\frac{n}{2}(n-3)+\frac{\left[\frac{n}{2}(n-3)\right]\left[\frac{n}{2}(n-3)-1\right]}{2}$$

$$=\frac{n}{2}(n-3)+\frac{n(n-3)\,(n^2-3n-2)}{8}=\frac{n(n-1)\,(n-2)\,(n-3)}{8}.$$

II. Solution by the PROPOSER.

A *complete* polygon of n sides is formed by n intersecting lines, and the first question is, how many lines will join the points of intersection of n intersecting lines. n lines can intersect in $\frac{n(n-1)}{2}$ points. From each of these points there can be drawn the other $\frac{n(n-1)}{2}-1$ lines. Therefore, from $\frac{n(n-1)}{2}$ points, $\frac{n(n-1)}{2}\left[\frac{n(n-1)}{2}-1\right]$, of which, evidently, only half can be taken; consequently, the required number of lines is $\frac{1}{8}(n+1)n(n-1)\,(n-2)$. Since each line drawn from $\frac{n(n-1)}{2}$ points cuts $n-2$ lines, we must subtract $\frac{n(n-1)}{2}(n-2)$ from the last result, in order to obtain the number of diagonals of a complete polygon of n sides. Therefore the required number of diagonals is

$$\begin{aligned}&\tfrac{1}{8}(n+1)n(n-1)\,(n-2)-\tfrac{1}{2}n(n-1)\,(n-2)\\ &=\tfrac{1}{8}n(n-1)\,(n-2)\,(n-3),\end{aligned}$$

or, more briefly, $3\binom{n}{4}$.

Also solved by Jeannette Brooks and A. H. Holmes.

CALCULUS.

302. Proposed by PROFESSOR L. E. DICKSON, Ph. D., The University of Chicago.

Find an algebraic integral of

$$LCy''+[18L(s-x^2)-2kC]y'+[L(\tfrac{2}{3}k-10x)-8k(s-x^2)]y=0,$$

where $L=2kx+3s-k^2$, $C=12sx-4x^3-t$, $k^4-6sk^2-tk-3s^2=0$. The roots of the determining equation are 0, $-\frac{1}{2}$ for a root of $C=0$; 0, 2 for a root of $L=0$; and 1 and $\frac{3}{2}$ at infinity.

No solution of this problem has been received.

303. Proposed by C. N. SCHMALL, New York City.

If $A=\int_0^1\frac{dx}{\sqrt{(1-x^4)}}$, express A in terms of Gamma-functions. [Part of ex. 39, p. 474, Bromwich's *Theory of Infinite Series.*]